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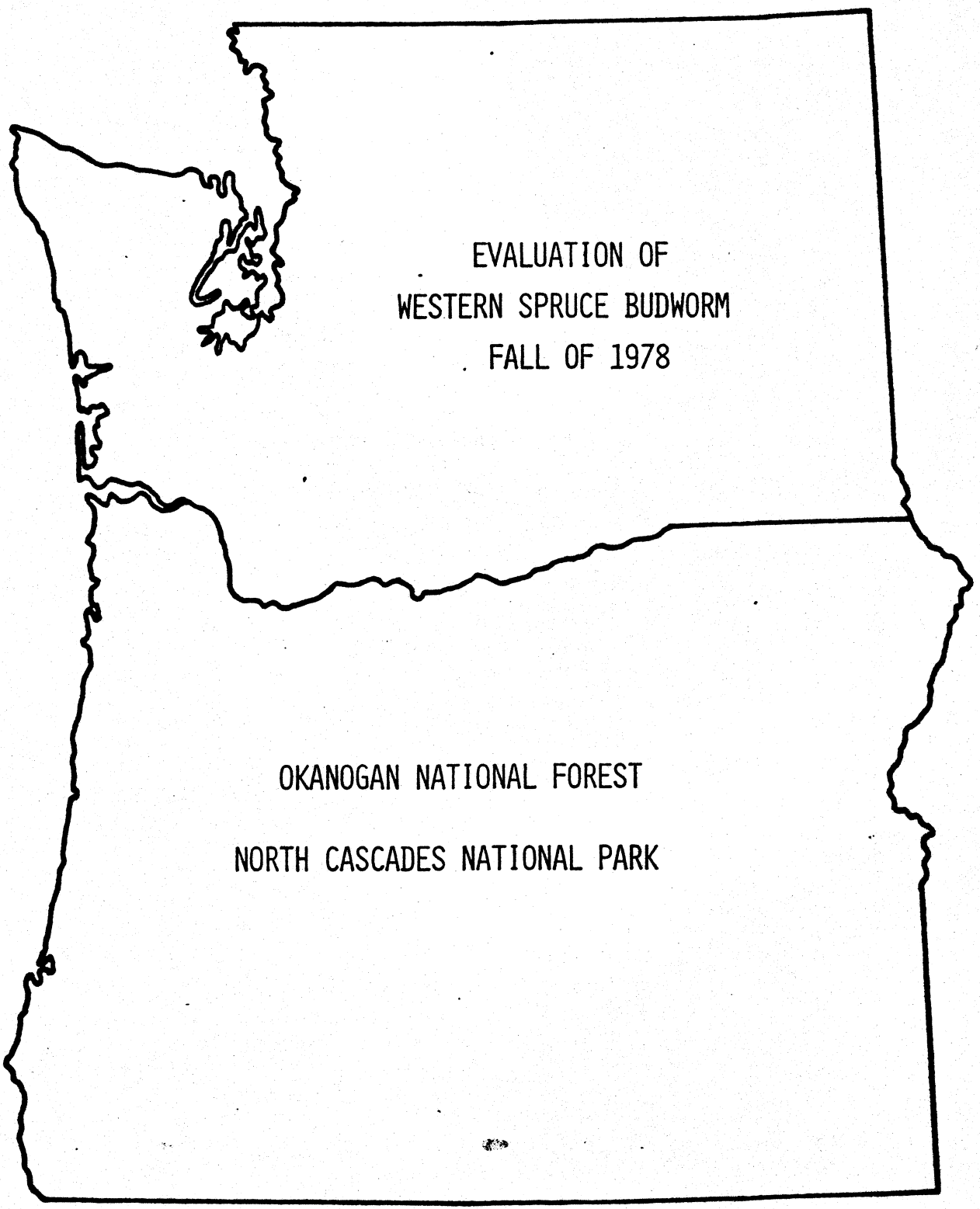

EVALUATION OF
WESTERN SPRUCE BUDWORM
FALL OF 1978

OKANOGAN NATIONAL FOREST

NORTH CASCADES NATIONAL PARK

Entomological Evaluation of Western Spruce Budworm Fall of 1978 on Okanogan National Forest and North Cascades National Park

Introduction

The current western spruce budworm outbreak on the Okanogan National Forest and North Cascades National Park was first recorded on 240 acres in the Wolf Creek drainage of the Methow Valley during the summer of 1970. This infestation gradually increased in size until 427,000 acres of visible defoliation were mapped in 1976. Chemical control programs applied to 132,000 heavily infested areas of the Okanogan National Forest during 1976 and 1977 succeeded in reducing budworm populations. Only 131,000 acres of defoliation were visible in August 1978.

Technical Information

Causal Agent: Western spruce budworm, *Choristoneura occidentalis*, Freeman.

Host Trees: Primary hosts of western spruce budworm are Douglas-fir, *Pseudotsuga menziesii* (Mirb.) Franco, and grand fir, *Abies grandis* (Doug.) Lindl. Budworm is feeding in lesser amounts on subalpine fir, *Abies lasiocarpa* (Hook.) Nutt., Pacific silver fir, *A. amabilis* (Doug.) Forb., and Engelmann spruce, *Picea engelmannii*, Parry. Western larch, *Larix occidentalis* Nutt., is lightly defoliated when in association with preferred hosts.

Location and Extent of Outbreak: This evaluation covers that portion of the north-central Washington outbreak located on the Okanogan National Forest, the North Cascades National Park, and adjacent State and private lands. Aerial detection surveys for budworm defoliation during August 1978 indicated the outbreak to be widespread throughout most of the susceptible host type.

Life Cycle and Damage: Budworm can usually be found in low numbers throughout the western United States and Canada. Damage caused by these populations is not noticeable. However, when outbreak numbers occur, defoliation of Douglas-fir and true firs becomes serious, resulting in growth loss, top kill, and tree mortality.

One generation is produced per year. Eggs are laid in masses on host tree needles in late summer and hatch occurs in 10 to 14 days. Small larvae do no feeding at this time, but migrate to protected overwintering sites on host trees. When buds swell in the spring, larvae leave hibernation and move to the expanding buds where they mine and feed on the new foliage. As the new foliage flushes, the larvae web new needles together and feed within this protected site. Sometimes larvae also feed upon both male and female flowers, destroying their reproductive potential. Larvae usually go through six stages of development referred to as instars and reach full maturity 30 to 40 days after attacking buds.

Pupation usually occurs in a mass of webbing and partially eaten needles towards the branch tip. Adults emerge from the pupae in 1 to 2 weeks, mate, and females lay eggs within 7 to 10 days, and then die.

Environmental Factors: Warm, dry, spring weather and an adequate supply of new foliage reduces the period required for budworm development. This shortening of the life cycle reduces the time available for predators and storms to reduce the larval populations. Two major environmental factors contributing to the current outbreak may have been the warm, dry springs during the early 1970's and the pure stands of Douglas-fir and grand fir located in the Methow Valley.

An evaluation of the parasite complex and its density and effect within the budworm outbreak was begun this summer, but results are not available as yet. No significant number of budworms was found that had obviously been killed by disease.

Methods

Research studies and many years of field experience have shown that the density of egg masses are indicative of the number of larvae which will attack buds the following spring. Table 1. Since egg masses are available for sampling for over 6 months, they provide an excellent sampling point for large infestations.

Table 1--Western spruce budworm egg mass densities and expected defoliation the following spring.

Egg masses per 1,000 square inches	Resulting defoliation
.1 to 1.3	very light
1.4 to 3.5	light
3.6 to 8.9	moderate
9.0 to 17.7	heavy
17.7 up	very heavy

Survey plots consisting of three randomly selected host trees on 1 acre of land were established at time of sampling to determine the density of egg masses. An attempt was made to locate one plot per section in the 1978 infested areas outside the control units. In roadless areas and in the National Park, the number of plots was limited to five per drainage due to time and manpower limitations. On the four largest control units sprayed during 1977, an attempt was made to locate and collect from the 26 plots/unit used in evaluating the spray project's efficacy. Some of these plots had been logged and could not be sampled. On the remaining small control units, one plot was located in each section. As time permitted, additional plots were located within a mile or two of, but outside, the visible infested area, to determine spread of the infestation during the moth's flight.

Sample trees were limited to Douglas-fir or true firs small enough (25-50 feet) to be sampled at midcrown with a 16-foot pole pruner. Two 30-inch long bud bearing branches were removed from opposite quadrants of each of three trees per plot.

Plot number, tree species, sampling date, and location by township, range, and section were recorded for each plot. Each branch was measured for foliated length and width then placed in a separate paper bag and kept cool until ready for examination in the laboratory.

In the laboratory, the foliage was examined, and any needle containing anything suspected as being part of an egg mass was removed and placed in a small Petri dish with the plot number recorded on the bottom. Using a microscope, an entomologist examined all these needles and separated the egg masses into two categories; new (summer 1978) and old (1977 or earlier). The new egg masses per 1,000 square inches of foliage was then calculated using the measurements taken earlier in the field.

Egg mass density figures were recorded at each plot's location on a map. Areas were then plotted to show the degree of defoliation that could be expected in 1979 using values established by Carolin and Coulter (1972).

Results

1. Little, if any, reinfestation occurred on the seven control units totaling 132,000 acres chemically treated with SEVIN 4 Oil in 1976 and 1977. Egg counts on 123 plots within these sprayed areas averaged less than two-tenths of an egg mass per thousand square inches of foliage. Very light, if any, defoliation should occur in these areas during 1979.

2. Average new egg mass counts of 6.47 in the Bridge Creek drainage of the National Park and 4.02 on the Mt. Hull area of the Tonasket Ranger District indicate moderate defoliation can be expected in these two areas during 1979.

3. Egg mass counts of less than 3 per 1,000 square inches of foliage were found in the Buttermilk, Cedar Creek, Conconully, Robinson Creek, Summit, and Twisp River areas which had been considered for chemical control during 1978. Light defoliation is expected in these areas during 1979.

4. No significant spread of the infestation was detected during 1978. Egg counts from 223 plots located in host type around old infestation centers were either zero or down from former years.

Discussion

1. Old control areas - On plots in the 132,000 acres sprayed with SEVIN 4 Oil for budworm control, egg mass counts showed few or no egg masses. Average counts on these seven areas ranged from .06 to .35. Prior to control, all had average counts in excess of 5.2 (Table III). Budworm defoliation in these areas during 1979 should be very light if visible at all.

2. Bridge Creek - An area of approximately 7,500 acres in the Bridge Creek drainage extending from Fireweed Campground to North Fork Campground along the Pacific Crest Trail in the North Cascades National Park was heavily defoliated from 1975 to 1978, and as a result top kill is common and some scattered tree mortality has occurred throughout the area. Egg mass counts on ten plots in the area averaged 6.47, the highest encountered in this survey. Moderate to heavy defoliation can be expected during 1979 which will result in considerable more top kill and tree mortality.

3. Buttermilk - Includes the upper drainages of Newby and Buttermilk Creeks originally scheduled for spraying in 1977. Spraying was terminated early that year when extremely hot weather accelerated budworm pupation. Past damage has been moderate, and 1978 defoliation was also moderate. Egg mass counts were down from 4.2 in 1977 to 1.9 in 1978. Light defoliation can be expected during 1979.

4. Cedar Creek - One of the oldest and most heavily damaged areas of the current outbreak consists mainly of the Cedar and Huckleberry Creek drainages on the Winthrop District of the Okanogan National Forest. Although defoliation was moderate in 1978, egg mass counts dropped from an average of 4.0 to presently 2.1. Some individual plot counts were as high as 7.9, indicating potential for overall light defoliation with spots of moderate and heavy defoliation.

5. Conconully - This relatively new area of the infestation was moderately defoliated in 1977 and 1978, located along the Salmon Creek road. Kerr, Oriole, and Cottonwood Campgrounds a few miles north of the town of Conconully are included in this unit. Budworm larval populations were high during the summer of 1978 and consumed much of the current foliage. Fall egg counts were low, averaging 2.3, so only light defoliation is expected in 1979.

6. Mt. Hull - Only small patches of light defoliation were observed on the southeast side of Mt. Hull during 1976 and 1977. However, in 1978, defoliation spread over most of the lower elevations of this mountain located just east of Orville and 6 miles south of the Canadian border. Egg counts on the nine plots surveyed in this area averaged 4.02 which indicated that defoliation can be expected to increase to moderate during 1979.

7. Robinson Creek - The infestation in this area includes approximately 18,000 acres located along the Methow River, Rattlesnake, and Robinson Creek drainages and include Ballard, Rattlesnake, River Bend, and Robinson Creek Campgrounds. Considerable top kill has occurred over the past 3 years in the vicinity of these Campgrounds. However, the egg mass counts dropped to 2.1 in 1978 from 5.3 in 1977. The infestation in this area appears to be on a downward trend, and only light defoliation is expected in 1979.

8. Summit - Adjacent to and immediately south of the Loup Loup Control Unit that was treated during 1977, this is a high value timber production area on the Twisp District. The parts of Benson Creek and Finley Creek drainages which are serviced by Forest Service Roads 335, 3310, and 321 are included in this area. Egg mass counts during the fall of 1977 averaged 4.4, but the defoliation during 1978 was less than expected. Egg counts in the fall of 1978 were down to 1.3, and no more than light defoliation is expected during 1979.

9. Twisp River - This area in the upper end of the Twisp River drainage extends from Poplar Flat Campground to Roads End Campground, and includes the South Creek drainage. Past damage has been heavy, and some dead and damaged trees are being salvaged from the Campgrounds. Fall egg mass counts of 4.2 in 1977 and 2.5 in 1978 indicate a decline in population. Light defoliation is expected during 1979.

Recommendations

Defoliation during 1979 should be light or absent in most of the infested area except those mentioned below. Although there should be no need to reduce populations, land managers might wish to consider salvage sales in areas where past tree mortality has occurred. Hazard tree removal from campgrounds and high use recreational areas could be considered.

Egg counts in Bridge Creek and on Mt. Hull indicate moderate defoliation will occur during 1979. In six additional areas light defoliation is expected. An egg survey should be made in the fall to see if there is a population resurgence.

Appendix

Table II--Western spruce budworm egg masses on infested areas of the Okanogan National Forest and North Cascades National Park fall of 1978.

Area	No. Plots	Egg Masses 1000/sq. in.	Std. Error %
Bridge Creek	10	6.47	16.8
Buttermilk	8	1.92	27.2
Buzzard Lake	12	.35	56.8
Cedar Creek	30	2.09	16.3
Conconully	19	2.30	23.8
Goat Peak	8	.08	100.0
Loup	22	.18	38.5
Mazama	25	.02	100.0
Mt. Hull	9	4.02	23.6
Pearrygin	14	.17	55.5
Robinson Cr.	15	2.10	28.8
Summit	20	1.34	17.2
Thompson	18	.06	75.3
Twisp	24	.26	32.0
Twisp River	12	2.50	20.7

Table III--1978 egg masses on treated and untreated areas of the Okanogan National Forest and North Cascades National Park and degree of defoliation predicted for 1979.

Areas treated with SEVIN	Egg Masses 1,000 sq. in.	Degree Defoliation
Pearrygin	.17	Very light
Thompson	.06	Very light
Twisp	.26	Very light
Buzzard	.35	Very light
Loup	.18	Very light
Mazama	.02	Very light
Goat Pk.	.08	Very light

Mean of treated areas = 0.15 egg masses per 1,000 square inches

Untreated infested areas

Mt. Hull	4.02	Moderate
Bridge Cr.	6.47	Moderate
Buttermilk	1.92	Light
Twisp River	2.50	Light
Summit	1.34	Very light
Conconully	2.30	Light
Robinson Cr.	2.10	Light
Cedar Cr.	2.09	Light

Mean of untreated areas = 2.84 egg masses per 1,000 square inches

Referenced Cited

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